

Knowledge of physical activity, level of physical activity & functional performance in patients with type 2 Diabetes mellitus: A cross-sectional study

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Research Article

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Abstract

Background:

Physical activity is an important aspect in controlling Type 2 Diabetes Mellitus but a number of patients do not achieve adequate levels although its benefits are already established. While PA knowledge is assumed to influence behavior, evidence on its relationship with functional performance remains inconsistent.

Methods:

This cross-sectional study lasted six months and was carried out in KDMC areas collecting 63 participants with T2DM of 1 year duration aged 40–60 years. Method of sampling was purposive, targeting participants from diabetes outpatient departments and from advertisements in communities. Data collected included a Physical Activity Knowledge questionnaire, International Physical Activity Questionnaire and a Six-Minute Walk Test. Graphpad prism 10.5.0 was used to carry out statistical analysis, Shapiro-Wilk test was done to assess normality, Spearman's coefficient was employed to analyze any relationships.

Results:

Participants belonged to mean age of 51.53 ± 6.34 years, BMI 28.15 ± 6.01 and mean duration of diabetes of 6.66 ± 5.43 years. The overall mean of PAK score was 13.09 ± 2.36 , while that of Physical activity was 1145 ± 1288 MET-min/week and for the 6MWT was 471.4 ± 53.48 m. Functional grading was normal for 77.77% subjects and 22.22% mildly impaired while classification of PA levels through IPAQ-SF indicated that 36.50% achieved low PA levels, 57.14% moderate while only 6.34% high. The correlation analysis between the Pak score and 6MWT showed small nonsignificant relationship ($r = 0.025$ and $p = 0.84$) as was between physical activity level and 6MWT ($r = 0.149$ $p = 0.24$).

Conclusion:

The study found that although the participants recorded moderate physical activity levels, the participants exhibited a fair amount of physical activity knowledge that however did not relate significantly with functional performance. This means that there is need for intervention modalities beyond Pak and reported physical activity to improve on outcome of T2DM management.

1. Introduction

Globally the number of people prevailing with diabetes in 2019 is estimated to be 9.3% (463 million people). This number is expected to go up to 10.2% (578 million people) by 2030. By 2045 the number is

expected to reach 10.9% (700 million people)[1]. According to a recent report from the National NCD Monitoring Survey (NNMS) the diabetes rate in India was 9.3% in 2018 and similar kind of numbers have been reported by IDF. They say that in 2021 the diabetes rate was 9.6% and is estimated that it will go up to 10.4% by 2030[2]. The long-term effects of diabetes can cause damage, dysfunction and organ failures. This includes retinopathy leading to blindness, nephropathy leading to renal failure and neuropathy increasing the risk of foot ulcers, amputation and charcot joints. It also results in autonomic dysfunction.

Physical activity is important to health in all domains, and is a key contributor to reduced risk of diabetes through improved glycemic control and cardiovascular health. Walking was effective in lowering blood glucose and HbA1c in elderly individuals with type 2 diabetes [3]. The World Health Organization (WHO) recommendations on physical activity for persons with type 2 diabetes: 1) Adults with T2DM should engage in 150 to 300 minutes/week of moderate-intensity aerobic physical activity. 2) Alternatively, they can do 75-150 minutes of vigorous-intensity aerobic physical activity weekly. 3) A combination of moderate and vigorous-intensity activity is also appropriate [4]. Previous systematic review and meta-analysis showed that resistance training (RT) is an effective exercise modality for decreasing HbA1c levels in adults with T2DM [5].

There is an inverse association of physical activity with cardiovascular disease (CVD) and mortality in the general population. Associations of physical activity with CVD and mortality indicate that high levels of physical activity are related to substantial decreases in the risk of CVD. The finding shows that total mortality decreases by 20-30% for every 1000 kcal/week, and clinical findings confirm that exercise improves the lipoprotein profile and glucose levels in diabetic patients [8]. Obesity and lower levels of physical activity are strongly related to the development of type 2 diabetes, since these factors contribute to insulin resistance. Therefore, physical activity is pivotal in the prevention of type 2 diabetes and the modification of lifestyle behaviors [9].

Despite the mentioned recommendations, a significant proportion of patients with T2DM remain physically inactive due to various barriers such as denial of the disease, lack of knowledge about the condition, limited time, inability to associate exercise with glucose control, lack of awareness about obesity, and insufficient emphasis by healthcare providers. By contrast, there are a few factors that facilitate physical activity, including patient education and encouragement, ongoing counseling and follow-up, social support from family and friends, recreational and indoor activities, socialization, and aging processes [6]. Knowledge about physical activity is an essential predictor of physical activity among patients. The IPAQ-SF is a self-administered physical activity questionnaire that estimates levels of activity and sitting time and categorizes them as either low, moderate, or high. It helps calculate total physical activity in MET-min/week and sitting time. It is designed for young and middle-aged adults (15-69 years) [7].

Despite the substantial evidence emphasizing the role of physical activity in glucose regulation and the overall improvement of patients' well-being, most individuals with diabetes remain physically inactive.

Self-efficacy, education, and professional support are some of the factors associated with adherence to physical activity. Although general knowledge about the benefits of physical activity is believed to predict healthy physical activity patterns among patients with T2DM, prior research provides conflicting evidence on this relationship. The association between physical activity, physical function and knowledge among patients with type 2 diabetes is understudied, especially in the local community. Therefore there is a need to conduct a study to determine the role of knowledge of physical activity in the prediction of physical activity. Thus the objective of this study is to assess the relationship between knowledge about the physical activity level and capacity in people with type 2 diabetes.

2. Methodology

I. Study design and participants

This cross-sectional study was performed for six months among the patients diagnosed as type 2 diabetes mellitus (T2DM). Participants were recruited from diabetes outpatient departments (OPDs) of Kalyan-Dombivli Municipal Corporation (KDMC) area, patients attending SIA College of Physiotherapy OPD, Rukminibai Hospital and by community advertisements and notice boards.

II. Sampling technique-

Purposive sampling was used. For sample size calculation, OpenEpi software was used. Assuming a prevalence of 9.6%, a confidence interval of 95% and a precision of 5%, the estimated sample size was 63 participants.

III. Inclusion criteria

Participants were included if

- had been diagnosed with T2DM for at least one year and were receiving regular medication;
- were between 40 and 60 years of age;
- belonged to either sex; and
- were able to understand English.

IV. Exclusion criteria

Participants were excluded if they had

- Gestational DM.
- Any lower limb or back related MSK injury which prevents the individual from doing physical activity.
- Any co-morbidities due to which physician has advised to take rest or lower the physical activity.

- Pain intensity on activity measured using the Numerical Pain Rating Scale >3 in lower limb and back.
- Any Known cardiovascular, pulmonary and neurological impairments and genetic abnormalities.
- Not willing to give consent.

V. Outcome Measures:

a. Physical Activity Questionnaire (PAK)

The measurement of PA knowledge was created from experts' consultations (i.e. a psychologist, an endocrinologist, a physiotherapist and a sports science expert), focus group discussion by investigators, and published research literature. The questionnaire consisted of 20 items that asked respondents about (i) basic understanding of PA's benefits (items 1 and 9–11), (ii) health benefits of PA in respect of diabetes (items 2–6), (iii) details of PA for diabetes treatment (items 7 and 8) and (iv) the types of PA conferring health benefits in cases of diabetes (item 12a–item 12i). The choices of response were "Agree", "Disagree", and "Don't know". The participants scored one point for each correct response and zero for an incorrect or "I don't know" response. The respondent's score out of 20 determined his or her degree of understanding of the influences of PA on diabetes-related health.

Reliability: 0.86[10]

b. International Physical Activity Questionnaire-Short form

IPAQ-SF assesses physical activity undertaken across a comprehensive set of domains including leisure time, domestic and gardening (yard) activities, work-related and transport-related activity. The IPAQ-SF asks about three specific types of activity undertaken in the three domains introduced above. The specific types of activities that are assessed are walking, moderate-intensity activities and vigorous intensity activities; frequency (measured in days per week) and duration (time per day) are collected separately for each specific types of activity.

Reliability: 0.80

Validity: 0.30 [7]

c. Six Minute Walk Test

The 6-min walk test (6MWT) is a popular test for the objective assessment of the functional exercise capacity. The patient is asked to walk as far as possible along a 30-m low-traffic corridor for 6 min. The primary outcome measure is the 6-min walk distance (6MWD) in meters.

Reliability: 0.98

Validity: 0.76[11]

VI. Materials used for data collection

The materials used in the study included the PAK questionnaire, IPAQ-SF questionnaire, 6MWT record sheet, sphygmomanometer, stethoscope, pulse oximeter, cones, measuring tape, stopwatch, mechanical lap counter, chair and stationery materials.

VII. Procedure

Permission for conducting the study and ethical approval was obtained from the Institutional Review board of The SIA College of Health Sciences, College of Physiotherapy, Dombivli, India. A written informed consent was taken from all the participants of the study. They were included according to inclusion and exclusion criteria and a the demographic details were noted. A brief explanation regarding Physical activity knowledge (PAK) questionnaire, International Physical Activity Questionnaire- short form (IPAQ-SF) and 6minute walk test(6MWT) was given as follows:

- PAK questionnaire: The questionnaire consists of 20 items that are ask responders about - basic understanding of PA's benefits, health benefits of PA in respect of diabetes ,details of PA for diabetes treatment and ,the types of PA conferring health benefits in cases of diabetes The respondent's score out of 20 determined his or her degree of understanding of the influences of PA on diabetes-related health.
- IPAQ-SF: The short form measures PA across all domains of leisure time, work, transportation, and household tasks. Reported minutes per week in each category were expressed in metabolic equivalents (METs), resulting in a PA estimate independent of body weight and expressed in MET-minutes/week. The categorical score that refers to MET-minutes/week and the duration and frequency of PA, was then calculated to classify the participants into three levels of PA: low, moderate and high.
- 6MWT: The patients were asked to sit at rest located near the starting position, for at least 10minutes before the test starts. During this time, we checked for contraindications, measure vitals and make sure that clothing and footwear are appropriate. A "warm-up" or "trial round" was not performed before the test. Patients were instructed that the objective is to walk AS FAR AS POSSIBLE for 6 minutes, but don't run or jog. You have to walk a length of 30 meters back and forth around the cones marked at both ends. If probably you get out of breath or become exhausted, you are permitted to slow down, to stop, and to rest as necessary but resume walking as soon as you are able. Timer was started as participant start walking, and each time the participant returns to starting position a lap was considered. Post test, vitals, Borg dyspnea and fatigue level and total distance walked was recorded.

The values then received were further statistically analyzed and results were given

3. Statistical Analysis

The data obtained was entered in MS Excel. Statistical analysis was done using Graph Pad prism software. Descriptive statistics was done to summarize demographic characteristics and outcome measures. The normality testing was done using Shapiro wilk test for the obtained data before statistical analysis. Since the data was not distributed normally, Spearman rank correlation test was done. It helped to determine the relationship between physical activity knowledge, physical activity level and functional performance. A p- value of less than 0.05 was considered statistically significant.

4. Results

Participant characteristic -

In this study, 63 subject took part, among them 31 (49.20%) were male and 32 (50.79%) were female (Fig 1). The ages of the participants ranged from 40 to 60 years (mean 51.53 ± 6.34 years). The diabetes duration of all 63 participants was more than 1 year with a mean of 6.66 ± 5.43 years.

The average BMI of the participants was 28.15 ± 6.01 .The participants had an average score for Physical Activity knowledge (PAK) of 13.09 ± 2.36 .

An average Physical Activity (MET-min/week) of 1145 ± 1288 was found among the participants.

An average distance covered by participants in the 6MWT was found to be 471.44 ± 53.48 meters. (Table 1)

Table 1: Baseline characteristics of participants

Variables	Mean and Standard Deviation
Age (years)	51.53 ± 6.34
Duration of diabetes (years)	6.66 ± 5.43
Body mass index	28.15 ± 6.01
PAK score	13.09 ± 2.36
6MWT distance	471.44 ± 53.48

Table 1: Baseline characteristics of participants

The International Physical Activity Questionnaire (IPAQ-SF) was administered to 63 participants. Of these, 23 (36.50%) were classified as low physical activity, 36 (57.14%) were characterized as moderate physical activity and 4 (6.34%) were determined to have high physical activity (Fig 2).

Table 2: Functional performance categories based on the percentage of predicted six-minute walk distance

Grade	% of Predicted Distance	Functional status	Interpretation
5	>100%	Excellent	Exceeds expected performance for age/sex
4	80–100%	Normal	Within expected range of functional capacity
3	60–79%	Mild Impairment	Slight reduction in aerobic endurance
2	40–59%	Moderate Impairment	Noticeable functional limitation
1	<40%	Severe Impairment	Significant reduction; may indicate serious pathology

The functional performance of participants was evaluated using the 6MWT, with the average distance covered by participants being 471.44 ± 53.48 meters (Table 2). The proportion of anticipated distance walked by participants is categorized for statistical examination is as follows

Based on the 6MWT grades related to participants' % predicted distance, 49 (77.77%) participants are categorized as having normal functional status, while 14 (22.22%) participants are classified as having mild impairment in functional status. (Fig 3)

Normality testing

Statistical analysis of the data was conducted using GraphPad Prism 10.5.0 software. The data were tested for normality using the Shapiro-Wilk test for normal distribution and the data was not normally distributed (Table 3), (Graph 1)

Table 3.: Results of the Shapiro-Wilk normality test

Test for normal distribution	PAK Score	6MWT distance	MET-min/Week
Shapiro-wilk test			
W	0.9270	0.7918	0.7231
P value	0.0009	<0.0001	<0.0001
Passed normality test (alpha=0.05)?	No	No	No

Graph 1. : Distribution of the study variables.

Correlation between physical activity knowledge and functional performance

The Spearman's correlation coefficient (r) was calculated between the average PAK score and the average distance walked in the 6MWT by participants, resulting in $r = 0.02547$, indicating a small

correlation. The outcome was determined to be statistically non-significant with a p value of 0.8404. (Graph 2)

Graph 2. : Correlation between PAK score and 6MWT distance

Correlation between physical activity level and functional performance

The Spearman's correlation coefficient (r) between the average IPAQ-SF MET-min/week and average 6MWT distance walked was $r = 0.1486$ indicating a small correlation . The result was found to be statistically non-significant with p value of 0.2375 (Graph 3).

Graph 3. : Correlation between PAK scores and six-minute walk distance

5. Discussion

The primary objective of this study was to assess knowledge of Physical activity in patients with type 2 Diabetes with Physical Activity knowledge (PAK) questionnaire as it is validated and reliable self-reported measure. PAK score was recorded into numerical from 0–20, more score considering better knowledge. The mean PAK questionnaire score was 13.09 ± 2.36 , indicating the population have good understanding about physical activity in management of diabetes mellitus.

The findings of the present study are consistent with those reported by Wafi et al. (2024), who observed that individuals with greater awareness and knowledge of physical activity guidelines tended to demonstrate higher levels of physical activity.[12] Similarly, Vaara et al. (2019) reported that awareness of physical activity recommendations among young adults was generally inadequate, emphasizing the need for greater efforts to improve knowledge and promote active lifestyles[13].

The second objective of this study was to assess the level of physical activity using IPAQ-SF in patients with T2DM. The mean Physical Activity (MET-min/week) of participants was 1145 ± 1288 . This suggests that the population has moderate level of physical activity

A study by Sheri R Colberg titled Physical activity level and exercise in patients with diabetes mellitus (2012) reported lower levels of physical activity among individuals with T2DM and identified several barriers, including physical discomfort, medical restrictions, fear of hypoglycemia, and lack of motivation. [14]. Whereas another study by M N Nor Shazwani Jr et al. assessment of physical activity level among individuals with type 2 Diabetes mellitus at Cheras health clinic, Kuala Lumpur (2012) concludes that low PA was associated with poor glycemic control especially in older age group.[15]

The third objective of this study was to assess the functional performance by 6MWT in patient with T2DM. The mean of distance walked by participants during 6MWT was 471.44 ± 53.48 meters. Out of 63 participants 77.77% population belongs to normal functional status and 22.22% belong to mildly impaired functional status.

The findings of the current study are in agreement with the findings of the study by Kimberlee A Gretebeck titled functional exercise improves mobility performance in older adults with type 2 diabetes (2019) which concludes that functional circuit exercise led to clinically meaningful improvements in 6MWT and mobility[16]. Likewise similar results are shown in study by Pfeifer LO et al. titled association between physical exercise interventions participation and functional capacity in individuals with type 2 diabetes, who observed that exercise interventions significantly improved many of these functional outcome[17].

The fourth objective of this study was to assess association between physical activity knowledge and function performance in patients with T2DM. However the objective does not pass normality and had a weak correlation which suggest that knowledge alone may not directly influence functional performance.

This finding is partially consistent with the study conducted by Mwimo et al. (2021), which reported that higher levels of knowledge and positive attitudes towards physical activity were associated with greater participation in physical activity[18]. Similarly, a study by Nokuthula Mtshali et al. titled diabetes-related knowledge, attitude and practice towards exercise and its benefits among individuals with type 2 Diabetes Mellitus (2024) states majority of the study participants reported poor knowledge and a negative attitude toward diabetes[19].

The fifth objective of this study was to assess the association between level of physical activity and functional performance in patients with type 2 diabetes mellitus. However, the objective does not pass normality and had weak correlation.

These findings differ from those reported by Stirai et al. (2020), who observed significantly better physical function among participants performing more than 150 minutes of physical activity per week[20]. Likewise, Rowlands et al. demonstrated a positive association between physical activity levels and measures of physical fitness among individuals with T2DM[21].

Overall, the findings of the present study indicate that although the participants demonstrated adequate knowledge regarding physical activity and moderate levels of physical activity, neither physical activity knowledge nor physical activity level showed a statistically significant association with functional performance.

6. Limitations

The present study has following limitations. The relatively small sample size may have limited the generalizability of the findings. IPAQ-SF is a self-reported questionnaire and if not properly explained to the participants, it could potentially overestimate the levels of physical activity. The motivation level of the participants may have affected the performance of the participants during the six-minute walk test (6MWT). Similarly, responses to the Physical Activity Knowledge (PAK) questionnaire may have been affected by social desirability bias and some questions may have been misunderstood due to differing levels of literacy, educational background or cultural context.

7. Conclusion

Majority of participants with T2DM are of age group 40–60 years and demonstrated a moderate level of physical activity. Participants in the study demonstrated good knowledge about physical activity. Our study concludes that there is a weak correlation between knowledge of physical activity and functional performance and also a weak correlation between level of physical activity and functional performance.

Abbreviations

- T2DM

Type 2 Diabetes Mellitus

- PA

Physical Activity

- PAK

Physical Activity Knowledge

- IPAQ

SF–International Physical Activity Questionnaire–Short Form

- 6MWT

Six–Minute Walk Test

- 6MWD

Six–Minute Walk Distance

- MET

min/week–Metabolic Equivalent Minutes per Week

- BMI

Body Mass Index

- WHO

World Health Organization

- HbA1c

Glycated Hemoglobin

- NCD

Non–Communicable Disease

- NNMS

National Non–Communicable Disease Monitoring Survey

Declarations

8. Acknowledgements

A sincere gratitude to the participants who were the integral part of this study for contributing their valuable time for this study. The authors also acknowledge the support and assistance provided by The SIA College Of Health Sciences, College Of Physiotherapy in recruitment of participants and their

management. Extended appreciation to everyone who contributed to successful completion of this study.

9. Author contributions

All the authors have contributed to the study. Data collection and management was carried out by the principal investigator. The authors contributed in statistical analysis of the collected data. The authors critically reviewed the manuscript and agreed to be accountable for all aspect of work.

10. Funding

No funding was received for the conduct of this study.

11. Data Availability

The data that support the findings of this study are not openly available due to reasons of sensitivity and are available from the corresponding author upon reasonable request.

12. Disclosure of potential conflicts of interest

There are no conflicts of interest.

13. Research involving Human Participants and/or Animals

The research involved human participants. All the ethical principles in accordance to the Helsinki declaration have been followed during the conduct of the study.

14. Informed consent

A written informed consent was taken from all the participants of the study. The scientific and ethical approval was taken for the study before data collection from the Institutional Review Board- SRC 'Scientific Review Committee' of The SIA College of Health Sciences, College of Physiotherapy, Dombivli, India.

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Graphs

Graphs 1-3 are available in the Supplementary Files section.

Figures

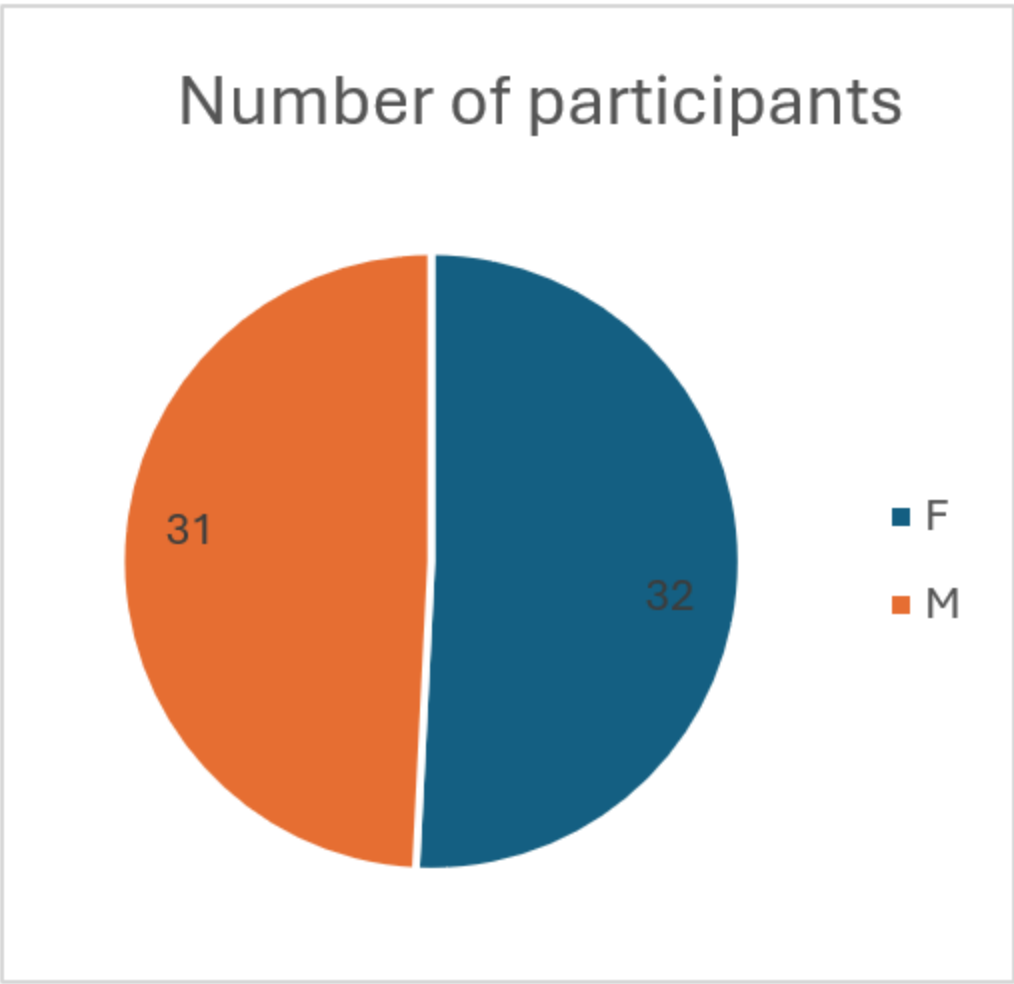


Figure 1

Distribution of participants based on their genders

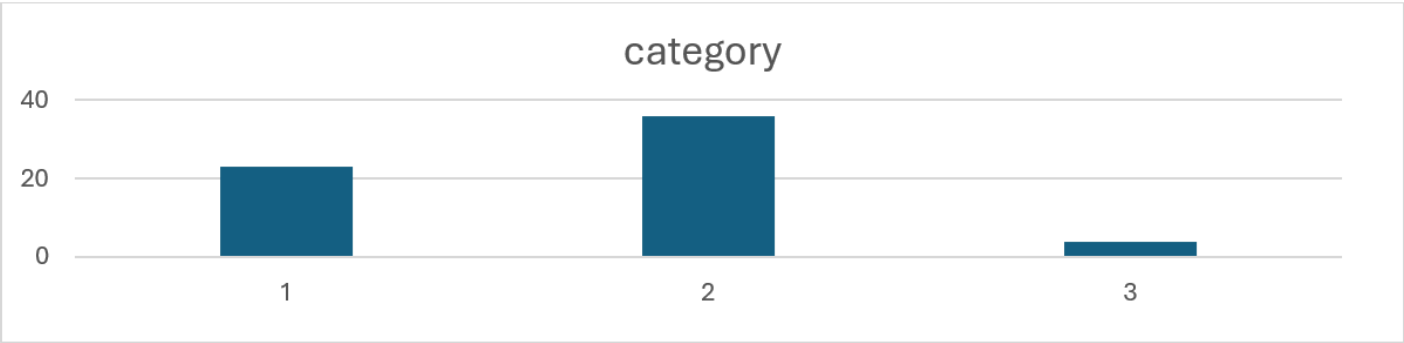


Figure 2

Distribution according to physical activity levels.

Number of participants

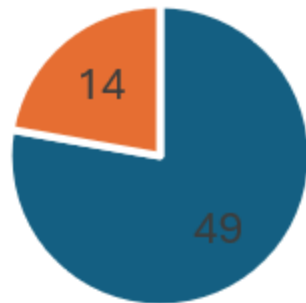


Figure 3

Distribution of participants according to their functional status.

Supplementary Files

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